

# MOT to Overcome the Valley of Death for New Technology-Based Small Firms in Japan

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## 1. Key words



### ● New Technology-Based Small Firms

Innovative and progressive small firms that base themselves on inventions generated by technological ideas and pursue leading-edge technology businesses focusing on their own intellectual properties, especially legally-protected patents.

### ● Valley-of-Death Phenomenon

In the commercialization process of leading-edge technologies that are based on IPs, including patents, a variety of difficulties need to be overcome. As a result, excellent leading-edge technologies frequently fail to be commercialized, which is called the valley-of-death phenomenon.

### ● MOT (Management of Technology)

METI (Ministry of economic, trade and industry in Japan) defines the essence of MOT as creation of profitability through the proper management of science and technology.



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## 2. Research Questions



## Research Questions

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- (1) Does the valley-of-death phenomenon really exist at each one of the three stages of NTBSF's in Japan?
  
  
  
  
  
  
- (2) If so, what types of causal factors exist behind the valley of death?
  
  
  
  
  
  
- (3) What types of Management of Technology (MOT) are required to overcome the valley of death at each stage?



### 3. Valley-of-death phenomenon



## Origin of Valley-of-death phenomenon

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The concept of the phenomenon can be traced back to the 1980s when American manufacturers lost their overwhelming competitive advantages.

“The United States is still unarguably the leader in basic research; the scale of its scientific enterprise is unequaled, and it is second to none in making new discoveries. Yet in the 1980s U.S. companies increasingly found themselves lagging behind their foreign rivals in the commercial exploitation of inventions and discoveries.” (Dertouzos, Lester and Solow(1989) )

“In the traditional system a new product is designed for function, and then the completed design is “thrown over the wall” to the manufacturing department, which is responsible for both process design and production operations.  
(Dertouzos et al. 1989)”



Valley of death as comprising three fundamental and interrelated gaps

(1)a financial gap, (2)a research gap, and (3)an information and trust gap

(Branscomb and Auerswald(2001) )

### **(1)The financial gap**

The gap between research funds that support both the creation of the idea and the initial demonstration that it works, and the investment funds needed to turn the idea into a market-ready prototype

### **(2)The research gap**

The gap between researchers' overly optimistic outlook and the difficulties in commercialization in the real world.

### **(3)The information and trust gap**

The training process, expectations, and stakes held by researchers, investors, and managers.

(Branscom and Auerswald, 2001, pp.11-12)



## IP strategy management

Knowledge management that incorporates IPs into the framework of corporate strategies or R&D capability to embed and enhance innovation capacity in the organization.(Okada(2003), p.26)"

## The causal factors of the valley of death when commercializing Ips

(Four issues which impact the failure of IPs to bring about revenues in many cases)

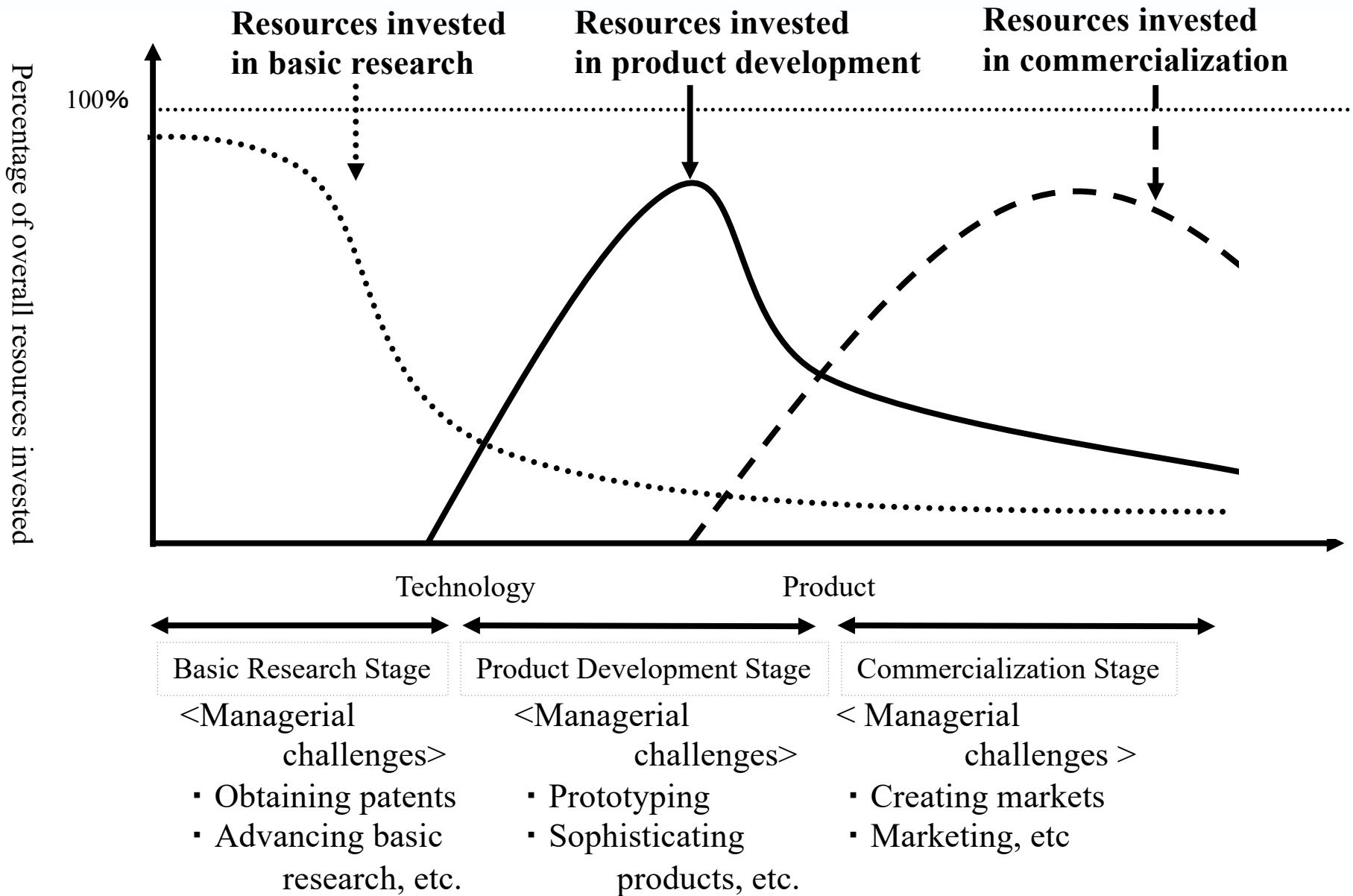
- (1) disconnects among technology, marketing, and finance departments
- (2) absence of an upper management that can offer “opportunities” to coordinate different departments/individuals and new visions
- (3) absence of cross-functional knowledge management
- (4) absence of “select and focus”-based IP strategies.

Okada(2003)



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#### 4. Three stages toward commercialization



Three stages toward commercialization and transition of major managerial challenges



### 【Basic research stage】

“outstandingly high in biotechnology, followed by nanotechnology while information technology and environmental technology industries showed a weaker science-linkage,” implying that the inability to convert basic research into technologies can be a causal factor of the valley of death in biotechnology and nanotechnology firms.

(Tamada et al(2003))

### 【Product development stage】

“The success of the development stage requires continuing support from senior management, creation of the new venture from ongoing business activities, organizational and strategic flexibility, and willingness to take risks and learn from experience.”

(Day George S., Paul J. H. Schoemak(2000), p.52)

"The Japanese manufacturing industry experiences a severe valley-of-death phenomenon in the product development stage and raises several causal factors that have been recognized by the companies it surveyed, which include issues with “extracting visions and conceptualizing demand,” “human resources,” and “linkage among internal departments and organizations.”

Inoue, Nihei and Hunaki(2003)

### 【Commercialization stage】

The product-based value (the difficulty of transition from product-based to market-based values) is the major causal factor of the valley of death in the commercialization stage.

(Moore(1991))



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## 5. Questionnaire-based survey



## Questionnaire-based survey

The questionnaire-based survey was conducted with managers and employees of NTBSFs who attended “Intellectual Property and Technology Management Program 2005,” who are seeking to establish businesses based on IPs including patents .

184 business entities (Managers and employees) were surveyed by a questionnaire delivered by email or postal mail.

116 business entities responded to the questionnaire delivered from mid-November to December 2004 (response rate: 63%).

Out of the 116 responding entities, 47 unlisted companies that are currently applying for or have already obtained patents were studied.

### Composition of technological areas of patents

Information technology	19%
Biotechnology and Health Care	15%
Nanotechnology	2%
No-response and Others	64%



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## 6. Reality and causes of valley of death at each stage of commercialization



## Existence of the valley of death at each stage

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	Basic Research	Product Development	Commercialization
Steadily producing positive results	21%	19%	9%
Facing some issues/challenges	30%	26%	34%
Facing a fair number of issues/challenges	19%	23%	32%
Facing a significant number of issues/challenges	13%	15%	19%
No response	17%	17%	6%

(N=47)



## Classification of the valley-of-death phenomenon at each stage

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	Basic Research	Product Development	Commercialization
Very serious	14%	13%	40%
Serious issues/challenges	21%	33%	30%
Somewhat serious	38%	30%	20%
Not very serious	17%	17%	10%
Not at all serious	7%	7%	0%
No response	14%	13%	40%

(Basic Research : N=29, Product Development: N=30, Commercialization: N=40)



## Evaluation of the valley-of-death factors

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	Basic Research	Product Development	Commercialization
Funding	38%	30%	30%
Human Resources	45%	40%	53%
Internal Linkage	31%	30%	30%
External Linkage	3%	10%	15%
Extracting Visions and Conceptualizing Demand	34%	47%	50%
Corporate Culture	24%	20%	23%
Motivation	31%	13%	18%

(Basic Research:N=29, Product Development:N=30, Commercialization:N=40)  
Multiple answers allowed



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## 7. Internal factors of MOT in NTBSF's



## Practice, Necessity of major internal MOT

### Necessity

	Clarification and Sharing of Market Needs	Speedy Management	Top-down Management	Creation of Roadmap
Very necessary	79%	64%	60%	64%
Fairly necessary	19%	34%	40%	28%
Not very necessary	2%	2%	0%	9%
Not at all necessary	0%	0%	0%	0%

### Practice

	Clarification and Sharing of Market Needs	Speedy Management	Top-down Management	Creation of Roadmap
Very engaged	15%	9%	32%	60% (Yes)
Fairly engaged	23%	40%	26%	
Not very engaged	43%	45%	34%	40% (No)
Not at all engaged	19%	6%	9%	

(N=47)



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## 8. External factors of MOT in NTBSF's



## Necessity

	Partners	Customers	Companies in Other Industries	Government Agencies	Competitors
Very necessary	45%	62%	32%	30%	15%
Fairly necessary	47%	28%	40%	36%	34%
Not very necessary	4%	0%	11%	19%	30%
Not at all necessary	0%	2%	6%	4%	11%
No response	4%	8%	11%	11%	11%

## Practice

	Partners	Customers	Companies in Other Industries	Government Agencies	Competitors
Very engaged	21%	19%	2%	6%	2%
Fairly engaged	32%	34%	28%	19%	13%
Not very engaged	28%	32%	30%	40%	30%
Not at all engaged	13%	9%	32%	26%	47%
No response	6%	6%	9%	9%	9%



# Necessity of Cooperation with external specialists

## Necessity

	Patent Attorneys	Banks	Lawyers	CPAs	Management Consultants	Temporary Staffing Agencies	VCs
Very necessary	49%	23%	26%	21%	13%	11%	15%
Fairly necessary	38%	45%	40%	43%	47%	45%	38%
Not very necessary	2%	13%	19%	21%	26%	17%	28%
Not at all necessary	0%	9%	4%	4%	6%	17%	11%
No response	11%	11%	11%	11%	9%	11%	9%

## Practice

	Patent Attorneys	Banks	Lawyers	CPAs	Management Consultants	Temporary Staffing Agencies	VCs
Very engaged	6%	15%	6%	11%	2%	6%	11%
Fairly engaged	32%	30%	32%	36%	23%	26%	6%
Not very engaged	26%	23%	26%	19%	30%	23%	23%
Not at all engaged	26%	23%	26%	26%	36%	36%	51%
No response	11%	9%	11%	9%	9%	9%	9%



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## 9. MOT to overcome valley of death



# Correlation between business performance and major MOT

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		Basic Research	Product Development	Commercialization
Internal MOT	Importance of IPs	0.221	0.04	0.137
	Top-down management	0.249	<b>0.379**</b>	0.027
	Roadmap	0.175	0.12	0.247
	Clarification and sharing of market needs	<b>0.364**</b>	<b>0.291*</b>	0.237
	Speedy management	0.256	0.156	-0.006
Relationships with External Parties	Establishment of relationships with customers	-0.096	-0.154	0.1
	Establishment of relationships with business partners	0.004	-0.054	0.215
	Establishment of relationships with companies in other industries	0.064	-0.057	0.123
	Establishment of relationships with government agencies	0.213	0.275	0.182
	Establishment of relationships with competitors	-0.149	-0.181	-0.052
Cooperation with External Specialists	Cooperation with patent attorneys	0.198	0.276	0.277
	Cooperation with banks	0.096	-0.057	0.193
	Cooperation with lawyers	-0.038	0.021	<b>0.163*</b>
	Cooperation with CPAs	-0.006	0.165	<b>0.455***</b>
	Cooperation with management consultants	0.014	-0.074	0.063
	Cooperation with temporary staffing agencies	-0.021	-0.265	0.119
	Cooperation with VCs	0.096	0.219	<b>0.478***</b>

\*: Positive at 10% level (by both-side test) \*\*: Positive at 5% level (by both-side test) \*\*\*: Positive at 1% level (by both-side test)

(N=47)



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## 10. Implications



The questionnaire survey of NTBSFs reveals under below.

- (1) NTBSFs recognize that a serious valley-of-death phenomenon exists at the commercialization stage.
- (2) The categories “human resources” and “extracting visions and conceptualizing demand” are perceived to be the main causes of valley of death through all stages.
- (3) There are some positive correlations between success in overcoming the valley of death and “clarification and sharing of market needs” at the basic research stage; “top-down management” and “clarification and sharing of market needs” at the product development stage; and “cooperation with external specialists” like certified public accountants (CPAs), venture capitalists (VCs), and lawyers at the commercialization stage.



### 【Questionnaire-based Survey】

- The majority of companies trapped in the valley of death identified “human resource issues/problems” as the causal factor of the phenomenon.
- A positive correlation was found between their progress in overcoming the valley of death at the basic research stage and their commitment to “clarification and sharing of market needs.”

### 【Interview-based survey】

Many of the companies expressed the importance of focusing on market needs, saying for example

- “It is important to initiate market need-oriented R&D activities”
- “We conduct market research before developing products and we only develop products that are expected to sell well.”

### 【Implications】

This suggests that securing high quality researchers and conducting market need-oriented R&D are most crucial in the basic research stage.



### 【Questionnaire-based Survey】

The majority of companies trapped in the valley of death in this stage found issues/problems with “extracting visions and conceptualizing demand” to be the major causal factor of the phenomenon.

Commitment to “top-down management” and “clarification and sharing of market needs” are positively correlated with progress in overcoming the valley of death.

### 【Implications】

In addition to the importance of market need-oriented basic research with high quality researchers, the visions and initiatives of upper management to turn basic research into a product are thought to be required.



### 【Questionnaire-based Survey】

- The most serious valley-of-death phenomenon was found to exist, with the major causal factor being the issues/problems of “human resources.”
- A positive correlation was identified between progress in overcoming the valley of death at the commercialization stage and commitment to cooperation with external specialists such as CPAs, VCs, and lawyers.  
⇒ It is assumed that the companies succeeding in overcoming the valley of death would commit their limited internal resources mainly to the major managerial issues and challenges while outsourcing other duties and tasks to external specialists.

### 【Interview-based survey】

- Many of the companies pointed out the necessity of securing employees with high expertise at the commercialization stage.
- “We hired sales specialists three years after the establishment of business to focus on marketing and sales, which pushed up our sales volume.”



"Economy One"

Existing companies, Universities, Research Institutions

“Economy Two”

Various organizations and systems that support the development of venture companies, that is, VCs, CPAs, lawyers, investment banks, a

Kenney and Burg(2000)

Kenney and Burg(2000) stresses the importance of a highly functioning “Economy Two” as being the regional strength of Silicon Valley, where NTBSFs are created one after another.

“Economy Two” is NOT fully playing its role in creating and developing NTBSFs in Japan.

⇒It is essential that NTBSFs utilize external specialists as “resource persons” in their MOT, especially at the commercialization stage.

Public Sector : To promotes the creation of technology ventures, strengthening the function of “Economy Two,” namely external specialists as resource persons, can be one of the most effective methods to develop NTBSFs in Japan



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## What should the Cluster Policy do to Foster NTBSF's? The Case of the Intellectual Cluster Policy of MEXT in Japan



## Why Cluster Policy?

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### Keywords

- De-industrialization of Japan
- Innovation
- Silicon Valley



# Industrial Cluster Policy

—19 projects nationwide, 5,000 companies and 200 universities—

Department of Economy, Trade and Industry, Okinawa General Bureau  
**Okinawa Industry Promotion Project**  
Information/health/environmental/processing trade fields  
About 110 companies and one university

Kansai Bureau of Economy, Trade and Industry  
(i) **Bio Five-Star Company & Tissue Engineering Project**  
Bio-related fields: About 220 companies and 36 universities  
(ii) **Active Manufacturing Industry Support Project**  
Manufacturing fields: About 360 companies and 25 universities  
(iii) **Kansai Information Technology Business Promotion Project**  
IT fields: About 260 companies and 4 universities  
(iv) **Kansai Energy & Environment Cluster Promotion Project**  
Energy fields: About 120 companies and 20 universities

Chugoku Bureau of Economy, Trade and Industry  
(i) **Project to Newly Generate the Machinery Industry in the Chugoku Region**  
Manufacturing fields: About 100 companies and 10 universities  
(ii) **Project to Form a Circulative Type of Industry**  
Environmental fields: About 80 companies and 9 universities

Kyushu Bureau of Economy, Trade and Industry  
(i) **Kyushu Recycle and Environmental Industry Plaza (K-RIP)**  
Environmental fields: About 190 companies and 18 universities  
(ii) **Kyushu Silicon Cluster Plan**  
Semiconductor fields: About 150 companies and 23 universities

Hokkaido Bureau of Economy, Trade and Industry  
**Hokkaido Super Cluster Promotion Project**  
Biotechnology/IT fields: About 280 companies and 15 universities

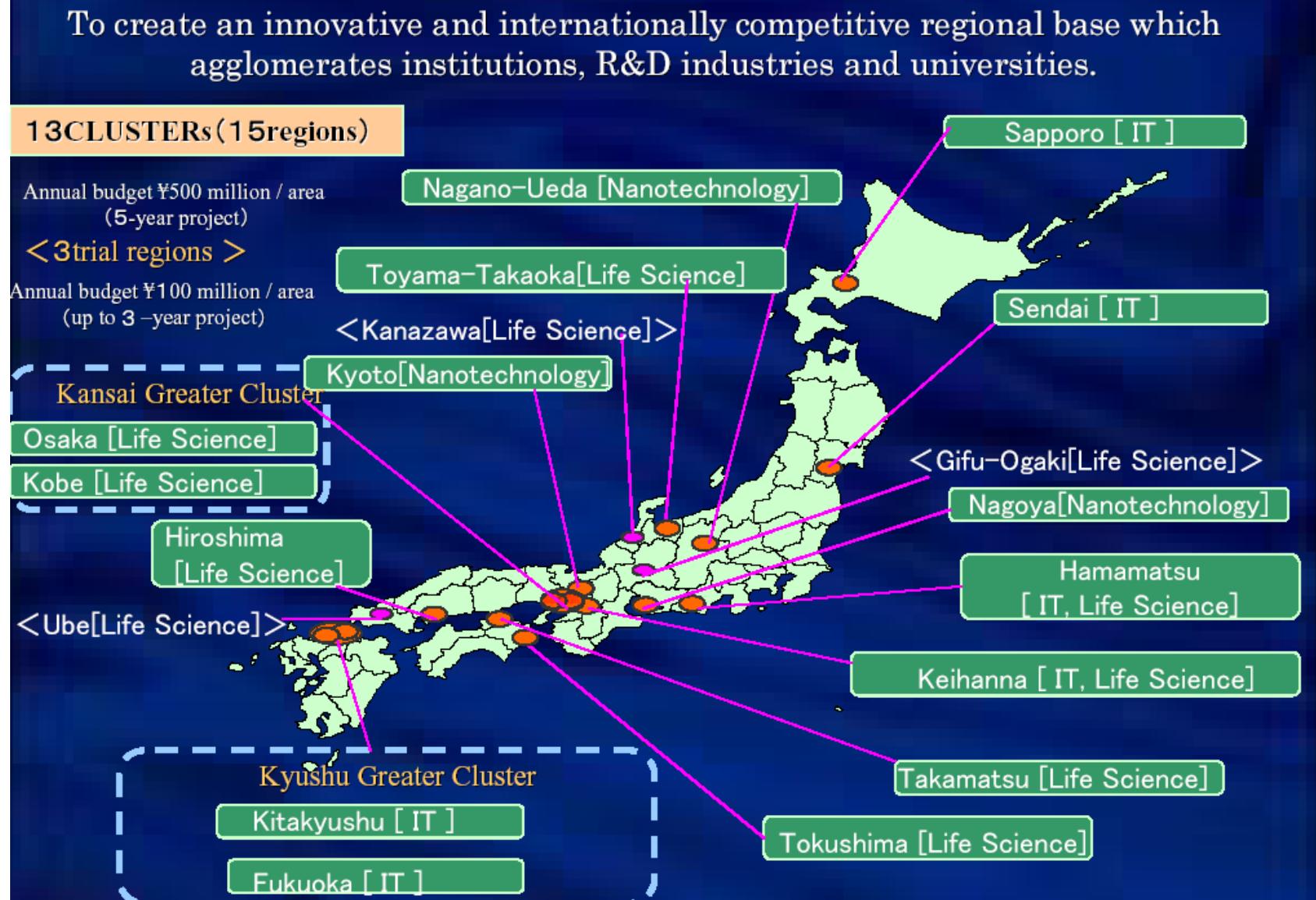
Tohoku Bureau of Economy, Trade and Industry  
(i) **Project to Promote Industries Corresponding to Aging Society (IT, biotechnology, manufacturing, etc.)**  
Health and welfare fields: About 180 companies and 19 universities  
(ii) **Project to Promote Industries Corresponding to Recycling-Oriented Society**  
Environmental fields: About 200 companies and 17 universities

Kanto Bureau of Economy, Trade and Industry  
(i) **Regional Industry Revitalization Project**  
• TAMA  
• Regions along the Chuo Expressway  
• Tokatsu/Kawaguchi areas  
• Sanennan Shin district  
• Northern Tokyo metropolitan area  
Manufacturing fields: About 1,590 companies and 50 universities  
(ii) **Fostering Bio-Ventures**  
Biotechnology field: About 170 companies and 9 universities  
(iii) **IT Venture Forum**  
IT field: About 170 companies

Chubu Bureau of Economy, Trade and Industry  
(i) **Project to Create Manufacturing Industry in Tokai Region**  
Manufacturing fields: About 480 companies and 28 universities  
(ii) **Project to Create Manufacturing Industry in Hokuriku Region**  
Manufacturing fields: About 120 companies and 11 universities  
(iii) **Project to Create Digital Bit Industry**  
IT fields: About 90 companies and 10 universities



# Intellectual Cluster Policy





## Result of Questionnaire-based surveys

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1. NTBSFs value cluster components such as “workforce and human resources,” “diffusion of technology and knowledge,” and “customers needs. On the other hand, hardware and system developments are progressing more in actual intellectual clusters
2. “Diffusion of technology and knowledge” is most highly valued in basic research, “diffusion of technology and knowledge” “workforce and human resources,” and “customers” in product development, “workforce and human resources” in manufacturing, and “customers” in sales.
3. Not only NTBSFs but also both external specialists and intellectual cluster project directors recognize the importance of “workforce and human resources” in view of fostering NTBSFs in the cluster.
4. NTBSFs demand existing universities and hardware in intellectual clusters to be utilized as effectively as possible

To fostering NTBSFs in intellectual clusters

- (1)Flexible and effective use of existing facilities
- (2)Enhancement of the human resources environment

(1) Flexible and effective use of existing facilities

- Intellectual clusters should attempt to utilize the existing facilities flexibly based on changes of economic and social conditions.—
- Development of hardware and system as typified by “components other than workforce and human resources” and “intellectual properties” are ahead of other factors in intellectual clusters.
- NTBSFs’ needs for prior measures for “effective use of existing facilities or policies”

(2) Enhancement of the human resources environment

- Enhancement of the human resources environment is required, such as the enrichment of external specialists to support NTBSFs in business.-
- NTBSFs, Intellectual cluster project directors, and external specialists value “workforce and human resources” highly among the cluster components.
- “Workforce and human resources” is not satisfactory at present, according to project directors.



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